WHAT IS CLAIMED IS:

1. A pump comprising:

a flexible diaphragm,

a rigid member,

an air seal formed between said diaphragm and said rigid member,

a puller member attached to said flexible diaphragm,

a drive member connected to said puller member which drive member is adapted to draw said puller member along with said diaphragm away from said rigid member, thereby creating a space between said diaphragm and said rigid member and forming a pressure region within said space,

a motor drive mechanism including said drive member to reciprocate said puller member to first draw said puller member away from said rigid member and then move said puller member back toward said rigid member,

an outlet in communication with said space between said diaphragm and said rigid member, and

a vacuum regulator device on said rigid member for adjusting the level of negative pressure within said pressure region when said diaphragm is moved away from said rigid member.

2. The pump of claim 1 wherein said vacuum regulator device comprises a rotary valve member mounted for rotational movement on said rigid member, an aperture being formed through said valve member, and at least one hole formed through said rigid member in communication with said pressure region, said valve member having a first position wherein said valve aperture and said rigid member hole are aligned to place said pressure region in communication with atmosphere, and a covered position wherein said valve aperture and said rigid member hole are unaligned with said valve member closing said rigid member hole.

3. The pump of claim 2 including a second hole formed through said rigid member, said valve member having a second position wherein said valve aperture and said rigid member second hole are aligned to place said pressure region in communication with atmosphere through said second hole, and wherein said pump has a maximum negative pressure generated in said pressure region when neither said first and second holes are aligned with said valve aperture, a minimum negative pressure generated in said pressure region when said second hole is aligned with said valve aperture, and a negative pressure generated in said pressure region intermediate to that of said maximum and said minimum when said first hole is aligned with said valve aperture.

4. The pump of claim 2 including a second hole formed through said rigid member, said valve member having a second position, said valve member having a channel formed therein overlying said rigid member with said valve member aperture extending into said channel, and wherein said pump has a maximum negative pressure generated in said pressure region when neither said first and second holes are aligned with said channel, a minimum negative pressure generated in said pressure region when said first hole is aligned with said channel, and an intermediate negative pressure to that of said maximum and minimum is generated when said first and second holes are aligned with said channel.

5. A pump comprising:

a flexible diaphragm,

a rigid member,

an air seal formed between said diaphragm and said rigid member,

a puller member attached to one of said flexible diaphragm and said rigid member,

a drive member connected to said puller member which drive member is adapted to draw said puller member along with one of said diaphragm and said rigid member from the other of said diaphragm and rigid

member thereby creating a space between said diaphragm and said rigid member and forming a pressure region within said space,

a motor drive mechanism including said drive member to reciprocate said puller member,

an outlet in communication with said space between said diaphragm and said rigid member, and

a vacuum regulator device on said rigid member for adjusting the level of negative pressure within said pressure region when said diaphragm is moved away from said rigid member.

6. A pump comprising:

a first member,

a second member movable relative to said first member,

an air seal formed between said first and second members,

a puller member attached to said first member,

a drive member connected to said puller member which drive member is adapted to draw said puller member along with said first member away from said second member, thereby creating a space between said first and second members and forming a pressure region within said space,

a motor drive mechanism including said drive member to reciprocate said puller member to first draw said puller member away from said second member and then move said puller member back toward said second member,

an outlet in communication with said space between said first and second members, and

a vacuum regulator device on one of said first and second members for adjusting the level of negative pressure within said pressure region.

7. A vacuum regulator device for a breastpump comprising:

a base in communication with a volume which is subject to a source of vacuum;

a rotary disk member mounted upon said base;

said base having at least one hole formed therein which extends into said volume;

said rotary disk member overlying said base and having an aperture therethrough which is alignable with said at least one hole.

8. A breastpump comprising:

first and second motor driven pumps each generating a negative pressure, with an outlet on each pump communicating with said negative pressure;

first and second breast shield assemblies including tubing for connection to a respective pump; and

a vacuum regulator associated with a respective pump, whereby the negative pressure generated by each said pump is independently regulatable.

9. The breastpump of claim 8 wherein each said motor driven pump includes a rigid shell, a flexible diaphragm sealingly mounted to said shell for movement relative to said shell, with a respective vacuum regulator being mounted on said rigid shell.

10. A pump for use with a breast shield assembly in the expression of mother's milk, comprising:

a flexible diaphragm,

a stationary cap member surrounding said flexible diaphragm,

an air seal formed between said diaphragm and said cap member,

a puller attached to said flexible diaphragm,

a follower connected to said puller member which follower is adapted to draw said puller member along with said diaphragm away from said cap member, thereby creating a space between said diaphragm and said rigid member and forming a negative pressure region within said space,

a motor drive mechanism including a cam member mounted to turn with a drive shaft with said follower mounted off-center on said cam member and off-axis to said drive shaft, said cam member when rotated by said

drive shaft causing said follower to reciprocate said puller member to first draw said puller member away from said cap member and then move said puller member back toward said cap member, and

an outlet in communication with said space between said diaphragm and said cap member which outlet is used to convey a pressure generated in said space, such as said negative pressure, to a breast shield assembly for use in extracting mother's milk.

11. The pump of claim 10 further including a pair of outlets in communication with said space between said diaphragm and said rigid member, each of said outlets being connectable to a respective breast shield assembly, and a closure member for closing one of said outlets when said pump is used with a single breast shield assembly, said closure member including a relief port for allowing a predetermined amount of air to flow into said pressure region when a negative pressure is generated within said pressure region to generally yield the same negative pressure at a single breast shield assembly as when using two breast shield assemblies without said closure.

12. A pump comprising:

a flexible diaphragm having a front side and a back side,

a stationary cap member surrounding said flexible diaphragm front side,

an air seal formed between said diaphragm and said cap member,

a puller attached to said flexible diaphragm,

a follower pivotably connected to said puller member which follower is adapted to draw said puller member along with said diaphragm away from said cap member, thereby creating a space between said diaphragm and said rigid member and forming a negative pressure region within said space,

a motor drive mechanism including a cam member mounted to rotate with a drive shaft with said follower movably mounted off-center on said cam member and off-axis to said drive shaft, said cam member when rotated by said drive shaft causing said follower to reciprocate said puller

member to first draw said puller member away from said cap member and then move said puller member back toward said cap member,

a puller guide having a channel formed therein, and a guide member which extends into said guide channel for constrained relative movement within said channel as said puller member reciprocates, said puller, puller guide and guide member cooperating together to maintain said puller moving along an axis generally perpendicular to said diaphragm, and

an outlet in communication with said space between said diaphragm and said cap member which outlet is used to convey a pressure generated in said space to a workpiece.

13. The pump of claim 12 wherein a follower is pivotably connected to said puller member which follower is adapted to draw said puller member along with said diaphragm away from said cap member, said motor drive mechanism including a cam member mounted to rotate with a drive shaft with said follower movably mounted off-center on said cam member and off-axis to said drive shaft, said cam member when rotated by said drive shaft causing said follower to reciprocate said puller member to first draw said puller member away from said cap member and then move said puller member back toward said cap member, and a stationary guide having a channel formed therein, and a guide member mounted on said puller member which guide member extends into said guide for constrained movement within said channel as said puller member reciprocates.

14. The breastpump of claim 13 further comprising:

a vacuum regulator communicating with said space between said diaphragm and said cap member.

15. The breastpump of claim 14 wherein said vacuum regulator comprises a disk which is rotatably mounted on said cap member, said disk having an aperture formed

therethrough which is selectively alignable with at least one opening through said cap member and extending into said space between said diaphragm and cap member.

16. The breastpump of claim 14 wherein said vacuum regulator device comprises a rotary valve member mounted for rotational movement on said cap member, an aperture being formed through said valve member, and at least one hole formed through said rigid member in communication with said pressure region, said valve member having a first position wherein said valve aperture and said rigid member hole are aligned to place said pressure region in communication with atmosphere, and a covered position wherein said valve aperture and said rigid member hole are unaligned with said valve member closing said rigid member hole.

17. The breastpump of claim 16 including a second hole formed through said rigid member, said valve member having a second position wherein said valve aperture and said rigid member second hole are aligned to place said pressure region in communication with atmosphere through said second hole, and wherein said pump has a maximum negative pressure generated in said pressure region when neither said first and second holes are aligned with said valve aperture, a minimum negative pressure generated in said pressure region when said second hole is aligned with said valve aperture, and a negative pressure generated in said pressure region intermediate to that of said maximum and said minimum when said first hole is aligned with said valve aperture.

18. A pump mechanism for a breastpump comprising:

a motor drive having a drive shaft output;

an eccentric mounted to be rotated by said drive shaft output;

a first and a second puller;

a first and a second expansible chamber, each said expansible chamber having a flexible diaphragm which is movable relative to a base member and is generally air sealed with respect to said base member so as to form a variable volume with said base member by movement of said diaphragm, each said diaphragm having a front side and a back side;

an outlet in communication with a variable volume of a respective chamber;

said first puller being connected to said first expansible chamber to move its flexible diaphragm relative to a respective base member, and said second puller being connected to said second expansible chamber to move its flexible diaphragm relative to a respective base member, said first and second pullers being connected to be moved by said eccentric in a push-pull arrangement, whereby as said eccentric is rotated one expansible chamber has a decreasing volume and the other expansible chamber has an increasing volume.

19. The pump mechanism of claim 18 wherein said first puller is connected to said flexible diaphragm of said first expansible chamber, said second puller is connected to said flexible diaphragm of said second expansible chamber, each said puller being pivotably mounted to said eccentric and extending in generally opposite directions from said eccentric with said expansible chambers on generally opposite sides of said eccentric, with said eccentric being mounted to said drive shaft.

20. The pump mechanism of claim 19 wherein each said base member is a rigid cap within which a respective diaphragm is received to move relative to a cap interior wall, said rigid cap for said first expansible chamber being formed integral with a breast shield assembly and the other rigid cap for said second expansible chamber being mounted to a pump mechanism housing, with said outlet of said second expansible chamber communicating with a second breast shield assembly via tubing.

21. The pump mechanism of claim 19 wherein each said base member is a rigid cap within which a respective diaphragm is received to move relative to a cap interior wall, each said rigid cap being formed in a pump mechanism housing, with said outlets of said first and second expansible chambers communicating with a respective breast shield assembly via tubing.

22. A pump mechanism for a breastpump comprising:

a motor drive,

a first and a second puller;

a mechanism connecting said first and second puller to said motor drive;

a first and a second expansible chamber, each said expansible chamber having a first member which is movable relative to a base member and is generally air sealed with respect to said base member so as to form a variable volume with said base member by movement of said first member,

a first outlet in communication with the variable volume of said first chamber and a second outlet in communication with the variable volume of said second chamber;

said first puller being connected to said first expansible chamber to move its first member relative to a respective base member, and said second puller being connected to said second expansible chamber to move its first member relative to a respective base member, said first and second pullers being connected to be moved in a push-pull arrangement by said by said mechanism, whereby as said motor is operated one expansible chamber has a decreasing volume and the other expansible chamber has an increasing volume.

23. A pump mechanism for a breastpump comprising:

a motor drive;

a first and a second expansible chamber, each said expansible chamber having an element which is movable relative to a base member with said element and base member being generally air sealed with respect to each other so as to form a variable volume between them by movement of said element relative to said base member, with an outlet in communication with a respective variable volume; and

a drive train being connected to said motor drive and to said first and second expansible chambers to move each expansible chamber element relative to a respective base member.

24. The pump mechanism of claim 23 wherein said element is a flexible diaphragm and said base member is a rigid member to which said diaphragm is mounted and having a respective outlet formed in said rigid member, said diaphragm being moved in relation to said rigid member by a drive train including an eccentric which is rotated by said motor drive, with a first puller mounted to move with said eccentric and connected to the diaphragm of said first expansible chamber, and a second puller mounted to move with said eccentric and connected to the diaphragm of said second expansible chamber, said first and second pullers extending in generally opposite directions from said eccentric so as to expand the volume of one expansible chamber while contracting the volume of the other expansible chamber as said eccentric rotates.

25. The pump mechanism of claim 23 wherein said element is a flexible diaphragm and said base member is a rigid member to which said diaphragm is mounted and having a respective outlet formed in said rigid member, said diaphragm being moved in relation to said rigid member by a drive train including an eccentric which is rotated by said motor drive, with a puller mounted to move with said eccentric and connected to a yoke, the diaphragms of said first and second expansible chambers being connected to said yoke so as to expand and contract the volumes of said expansible chambers in tandem as said eccentric is rotated.

26. A pump mechanism for a breastpump comprising:

a motor drive;

a first and a second expansible chamber, each said expansible chamber having an element which is movable relative to a base member with said element and base member being generally air sealed with respect to each other so as to form a variable volume between them by movement of said element relative to said base member;

a first outlet in communication with the variable volume of said first chamber and a second outlet in communication with the variable volume of said second chamber;

a drive train connected to said motor drive and to said first and second expansible chambers to move each expansible chamber element relative to a respective base member, and

a housing for said motor drive, expansible chambers and drive train;

said housing, said motor drive, said first and second chambers and said drive chain being arranged in a hand-held unit.

27. The pump mechanism of claim 26 wherein the base member of said first expansible chamber is a rigid cap attached to a first breast shield assembly within which the element of said first expansible chamber is received in sealing engagement, with said pump mechanism thereby being carried by said first breast shield assembly, and the base member of said second expansible chamber is a rigid cap within which the element of said second expansible chamber is received in sealing engagement, and further including tubing connecting the outlet of said second expansible chamber with a second breast shield assembly.

28. The pump mechanism of claim 27 wherein said element is a flexible diaphragm, said diaphragm being moved in relation to said cap member by a drive train including an eccentric which is rotated by said motor drive, with a first puller mounted to move with said eccentric and connected to the diaphragm of said first expansible chamber, and a second puller mounted to move with said eccentric and connected to the diaphragm of said second expansible chamber, said first and second pullers extending in generally opposite directions from said eccentric so as to expand the volume of one expansible chamber while contracting the volume of the other expansible chamber as said eccentric rotates.

29. A pump mechanism for a breastpump comprising:

a motor drive;

a first and a second expansible chamber, each said expansible chamber having an element which is movable relative to a base member with said element and base member being generally air sealed with respect to

each other so as to form a variable volume between them by movement of said element relative to said base member;

an outlet for each variable volume of a respective chamber;

a drive train connected to said motor drive and to said first and second expansible chambers to move each expansible chamber element relative to a respective base member, and

a housing having each said base member integrally formed therein, said housing further containing said motor drive, expansible chambers and drive train.

30. The breastpump of claim 29 wherein each said base member is a rigid hemispherical cap respectively formed in opposite sidewalls of said housing, the element of a respective first and second expansible chamber being received in sealing engagement with its respective cap, and further including tubing connecting the outlet of each said first and second expansible chamber with a respective breast shield assembly.

31. The breastpump of claim 30 wherein said element is a flexible diaphragm, said diaphragm being moved in relation to said cap by a drive train including an eccentric which is rotated by said motor drive, with a first puller mounted to move with said eccentric and connected to the diaphragm of said first expansible chamber, and a second puller mounted to move with said eccentric and connected to the diaphragm of said second expansible chamber, said first and second pullers extending in generally opposite directions from said eccentric so as to expand the volume of one expansible chamber while contracting the volume of the other expansible chamber as said eccentric rotates.

32. A housing for a pump mechanism of a breastpump comprising:

first and second housing parts which assemble to provide an interior space for containing pump mechanism components; and

a noise and vibration reducing material formed integral with said housing parts adjacent said interior space.

33. The housing of claim 32 further including a flexible diaphragm formed integral with each housing part.

34. A housing for a pump mechanism of a breastpump comprising:

first and second housing parts which assemble to provide an interior space adapted to contain pump mechanism components, and a flexible diaphragm formed integral with each housing part.

35. The housing of claim 34 wherein said flexible diaphragm is fixed within an opening defined in a respective housing part, and further including a rigid hemispherical cap member which is removably and sealingly mountable over said opening on the outboard side of each housing part, said cap member and respective diaphragm together forming an expansible chamber for generating air pressure variations therein.

36. The housing of claim 35 further including a noise and vibration reducing material formed integral with said housing parts adjacent said interior space.

37. A housing for a pump mechanism of a breastpump comprising a flexible diaphragm formed integral with the housing.

38. The housing of claim 37 wherein said flexible diaphragm is fixed within an opening defined in a respective housing part, and further including a rigid hemispherical cap member which is removably and sealingly mountable over said opening on the outboard side of each housing part, said cap member and respective diaphragm together forming an expansible chamber for generating air pressure variations therein.

39. The housing of claim 38 further including a noise and vibration reducing material formed integral with said housing parts adjacent said interior space.

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